

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of

Expanding Flexible Use in Mid-Band
Spectrum Between 3.7 and 24 GHz

GN Docket No. 17-183

REPLY COMMENTS OF GOOGLE LLC AND ALPHABET ACCESS

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I. Introduction and Summary

The comments filed in this proceeding are especially consistent in highlighting the promise of the 3.7–4.2 GHz band for more intensive use. As Google LLC (“Google”) and Alphabet Access (“Access”) have noted, flexible use of the 3.7–4.2 GHz band for both fixed and mobile services should be a foremost goal of the Commission’s near-term spectrum policy.¹ This band can be put to use immediately in point-to-point and point-to-multipoint (P2MP) configurations to support broadband access, while protecting incumbent users and preserving opportunities for future mobile use.

Specifically, P2MP fixed operations can be introduced to the band without causing harmful interference to incumbents, through the use of a central cloud-based coordination system. Since the exact locations and characteristics of incumbent fixed-satellite service (FSS) earth stations and fixed links are known, that information can be used to calculate maximum allowable power levels for P2MP systems as a function of azimuth, in order to avoid interference.

For mobile use, protecting FSS earth stations will be considerably more challenging. The comments indicate that the difficulty of providing such protection effectively requires clearing active, registered earth stations from some or all frequencies or geographic areas prior to mobile use. Although several solutions have been suggested, this clearing will take time.

The good news is that more intensive fixed use—especially permitting P2MP links under Part 101—can be approved in the 3.7–4.2 GHz band right away, without

¹ Comments of Google LLC and Alphabet Access in GN Docket No. 17-183 (filed Oct. 2, 2017).

impairing full flexible use in the future. One approach, discussed below, is to repack fixed links into only a portion of the 3.7–4.2 GHz band, once mobile-FSS coexistence issues have been resolved. The spectrum vacated by fixed users could be designated for exclusive mobile licensing. Full flexible use including mobile could additionally be allowed on a co-primary basis, via database-managed sharing of the portion of the spectrum that is occupied by fixed links. In this way, the band could become a locus of opportunity for both fixed and mobile broadband deployments in rural and urban areas.

II. Point-to-Multipoint Services Can Coexist with Incumbents in the 3.7–4.2 GHz Band

Point-to-multipoint operations readily can be coordinated with FSS and other fixed service uses of the 3.7–4.2 GHz band. The method to avoid interference is straightforward: Do not point P2MP beams toward the known locations of protected incumbent users. Implementation consists of just a few steps, all of which already are being put into practice in the 3.5 GHz Citizens Broadband Radio Service (CBRS) band. The steps are as follows:

1. A proposed P2MP network provides its location, height, antenna characteristics, bandwidth, and desired power level to a central cloud-based coordination system.
2. The central coordination system queries the database of incumbent sites and, after considering the aggregate signal strength level at incumbent sites due to previously established P2MP and point-to-point systems, provides to the

proposed P2MP network a maximum allowable EIRP (as a function of azimuth) in order to avoid interference with all registered incumbent sites.

3. The P2MP network must acknowledge and accept the EIRP restrictions for its base station, in order to be authorized to operate in the band.
4. The P2MP network proposes to the central coordination system the desired characteristics of its user terminals, such as location, antenna characteristics, bandwidth power level, and azimuth back toward the base station. The coordination system determines whether the emissions from each new terminal, when added to existing emissions from other terminals and base stations, will continue to meet the incumbents' interference objectives. If the interference criteria cannot be met, the proposed terminal will be denied access to the band unless existing transmitters are reconfigured to allow it.

These steps are generally similar to the ones undertaken by operators and Spectrum Access System (SAS) administrators to manage entry into the CBRS band, although the characteristics of the 3.7–4.2 GHz band make coordination much easier to accomplish. In the CBRS band, the principal incumbent use, military radar, is both dynamic and secret. The radar signals must be monitored in real time in order to be protected. In the 3.7–4.2 GHz band, by contrast, the exact locations and characteristics of incumbent FSS earth stations and fixed links will be known, recorded in a database, and rarely changed, making their protection vastly simpler. After cleanup of the FCC's C-band database and accurate registration of all FSS sites in the band, the coordination system will have full knowledge of all incumbent systems requiring protection.

Indeed, incumbent usage is sufficiently stable that operators of P2MP systems could query the cloud-based coordination system early in the process of evaluating a potential network deployment, and plan their RF design accordingly. Although P2MP networks sometimes will not be admissible (for example, an FSS site that uses the entire 3.7–4.2 GHz range in an urban area may block access to the band for a large portion of that city), P2MP use will be possible where FSS dishes are absent or use only a portion of the band.

National Public Radio (NPR), for example, indicates that it operates 475 public radio downlinks using transponders that operate from 3702–3858 MHz.² That means NPR is using a maximum of approximately 160 MHz of spectrum (including guard bands), leaving as much as 340 MHz of available spectrum in the 3.7–4.2 GHz range around every NPR downlink.

Protecting existing links will result in a “Swiss cheese” type of availability for frequencies and geographies. But partial availability for P2MP systems is better than leaving significant amounts of valuable broadband spectrum underutilized. Given the 500 MHz of available spectrum between 3.7 and 4.2 GHz—which is more than the cellular, PCS, AWS-1, AWS-2, AWS-3, 600 MHz, and both 700 MHz bands *combined*—there will be plenty of spectrum for all.

² Letter from Adam Shoemaker, Counsel, National Public Radio, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 17-183 (Nov. 8, 2017).

III. Point-to-Multipoint Services Can Coexist with Future Terrestrial Mobile Services in the 3.7–4.2 GHz Band

The opening comments suggest that, in contrast to expanding fixed service use, introducing mobile operations into the 3.7–4.2 GHz band will not be easy or quick. Dramatic regulatory and/or market actions will be required, and these will take substantial time to implement. There is, however, no need to delay fixed service entry while options for mobile entry are being studied and implemented. P2MP links and other new fixed services can be allowed now, without preventing robust mobile use later.

A. Commenters Identify Significant Coexistence Challenges for Mobile

The characteristics of C-Band FSS operations make coexistence with mobile services difficult. As discussed by satellite industry commenters, FSS signals travel long distances and therefore are received at low power levels,³ and separation distances between mobile handsets and FSS earth stations are difficult to enforce.⁴ If interference from mobile did occur, it could be difficult to locate the source of the interfering mobile signal.⁵

³ See Comments of General Communication, Inc. in GN Docket No. 17-183 at 11-12 (filed Oct. 2, 2017) (*GCI Comments*); Comments of National Public Radio, Inc. in GN Docket No. 17-183 at 10-11 (filed Oct. 2, 2017).

⁴ See Comments of the National Association of Broadcasters in GN Docket No. 17-183 at 7 (filed Oct. 2, 2017); Comments of the Satellite Industry Association in GN Docket No. 17-183 at 38-39 (filed Oct. 2, 2017); Comments of Walt Disney Company *et al.* in GN Docket No. 17-183 at 8 (filed Oct. 2, 2017).

⁵ *GCI Comments* at 12.

Mobile industry commenters forthrightly acknowledge these challenges.⁶

Accordingly, the record includes a variety of proposals for resolving mobile-FSS conflicts. Intel and Intelsat, for instance, jointly urge the Commission to adopt a market-based approach by which terrestrial mobile and FSS satellite operators could form commercial agreements to determine where mobile can be accommodated.

“Under this proposal,” Intel and Intelsat state, “incumbent FSS operators will be able to facilitate terrestrial mobile use in a manner that fully accounts for their costs, as well as allows the continued use of the downlink spectrum by satellite operators outside of areas where terrestrial use is enabled.”⁷ Other commenters support a database-driven sharing model similar to that implemented in the CBRS band.⁸ Still other commenters suggest relocating FSS operations to other spectrum such as the Ka- and Ku-bands,⁹ or confining satellite earth stations by rule to geographically remote areas where they would be less likely to receive interference.¹⁰

⁶ See Comments of T-Mobile USA, Inc. in GN Docket No. 17-183 at 14 (filed Oct. 2, 2017) (*T-Mobile Comments*) (“[I]t is not practical for mobile operators to coexist with large numbers of satellite receivers in [] urban areas”); see also Comments of AT&T Services, Inc. in GN Docket No. 17-183 at 9 (filed Oct. 2, 2017) (“the Lower C-Band . . . involves a requirement to accommodat[e] new facilities, including earth stations that may have to be rapidly deployed at temporary locations to support restoration after natural disasters or transient broadcast events”).

⁷ Joint Comments of Intelsat License LLC and Intel Corporation in GN Docket No. 17-183 at 3 (filed Oct. 2, 2017).

⁸ See Comments of Comsearch in GN Docket No. 17-183 at 3 (filed Oct. 2, 2017); Comments of Verizon in GN Docket No. 17-183 at 19 (filed Oct. 2, 2017) (*Verizon Comments*). Note that this approach assumes accurate earth station information and thus would require cleanup of the Commission’s IBFS database.

⁹ See *Verizon Comments* at 17; Comments of CTIA in GN Docket No. 17-183 at 10-11 (filed Oct. 2, 2017); Comments of Ericsson in GN Docket No. 17-183 at 7 (filed Oct. 2, 2017); Comments of QUALCOMM Incorporated in GN Docket No. 17-183 at 5 (filed Oct. 2, 2017).

¹⁰ *T-Mobile Comments* at 14-15.

These proposals collectively hold promise for eventual resolution of the mobile-FSS coexistence challenge. But any of them would require extensive review by the industry and the Commission, and significant time to implement. While they are encouraging routes for the Commission to explore, none ensures a path to speedy mobile entry. The Commission should be realistic about the mobile-FSS challenge, and not allow it to delay all expanded use of the 3.7–4.2 GHz band.

B. Following the Resolution of Mobile-FSS Interference Issues, Mobile and P2MP Can Coexist

In particular, there is no need to delay the expansion of fixed services while the Commission and industry resolve mobile-FSS issues. Once FSS services have been accommodated, licensed mobile service can be admitted without having to displace any fixed users that enter the 3.7–4.2 GHz band under the rules described above. Below we set out one approach—though not the only one—by which mobile use could be phased in across the 3.7–4.2 GHz range with no reduction in fixed services.

First, in anticipation of future flexible use, the updated Part 101 rules for the 3.7–4.2 GHz band should require all fixed service devices to be capable of operation across the full 500 MHz of the band. This requirement can be accomplished by adding to Rule 101.103 (“Frequency coordination procedures”) a requirement that “Stations that operate on any portion of the frequencies within the 3700–4200 MHz band must be capable of operating on all frequencies within that band.”¹¹ This will ensure that new

¹¹ Cf., 47 C.F.R. § 30.208 (operability requirement for 28 and 37–40 GHz bands); 47 C.F.R. § 96.39(b) (operability requirement for the 3550–3700 MHz Band); 47 C.F.R. §§ 27.2 and 27.50 (technical requirements adopted to promote interoperable LTE operations in the Lower 700 MHz

fixed operations can adapt to subsequent changes to frequency plans or allocations in the band. There is relatively little fixed service equipment in the 3.7–4.2 GHz range today,¹² and most of that equipment likely is operable across the full band; existing equipment that is not already operable across the band could be provided a reasonable period of time to come into compliance.

A flexible use allocation that includes mobile licensing then could be made to enable mobile use of (1) a portion of the band on a primary, exclusive basis, and (2) the remainder of the band on a co-primary basis. Starting the primary mobile allocation at 3700 MHz would make it contiguous with the CBRS band at 3550–3700 MHz, thus promoting efficiencies in mobile chipsets and equipment. If sized at 240 MHz (i.e., between 3700 and 3940 MHz), for example, this primary allocation would release roughly *three and a half times* as much exclusively licensed spectrum as the massively difficult 600 MHz incentive auction process. Taking advantage of the operability requirement described above, P2MP and other fixed services could be repacked into the remainder of the 3.7–4.2 GHz band.

In addition to exclusive allocations, mobile service could be allowed on a co-primary basis with fixed services. Geolocation databases such as simplified versions of the SASs developed by Google and others for the CBRS band could be used to allow opportunistic flexible use, while protecting all registered fixed links against harmful

band); 47 C.F.R. § 90.547 (interoperability requirement for transmitters operating on narrowband channels in the 769–775 MHz and 799–805 MHz bands).

¹² *In the Matter of Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd. 6373, ¶ 15 (2017).

interference. This is analogous to the protection of priority licensed point-to-point and P2MP Internet access links in the CBRS band against interference from General Authorized Access (GAA) users, except that protection in the 3.7–4.2 GHz band is simpler because there is no dynamic, top-tier incumbent user equivalent to the naval radars in the CBRS band. In other words, mobile services operated on a GAA basis in the 3.5 GHz band are admitted only if they will not interfere either with the highest-priority naval radars and FSS stations, or with priority licensees, whereas co-primary mobile services which are sharing 3.7–4.2 GHz spectrum with fixed operations would need to protect only those fixed operations.

By their nature, moreover, registered fixed service links are straightforward to protect and avoid: Their locations and characteristics are settled and known; new links are introduced relatively rarely; and the links tend to remain unchanged for years. This makes it easy to record current registration information in a spectrum management database and to ensure appropriate protection.

The foregoing framework could be implemented almost immediately for P2MP and fixed links following the C-band database cleanup, and very quickly for mobile upon the resolution of mobile-FSS interference issues. At the end of this process, hundreds of additional megahertz of spectrum would be available for fixed links, and mobile services would have access to the full 500 MHz of valuable mid-band spectrum, including exclusively licensed spectrum as well as coordinated spectrum. It is hard to imagine that any other spectrum initiative currently being considered by the Commission could yield

similarly dramatic results for wireless broadband deployment, including rural broadband, in so short a time.

IV. CONCLUSION

The Commission should move quickly to amend Part 101 of its Rules to permit expanded use of the 3.7–4.2 GHz band for fixed links, including P2MP services, on a non-interfering basis with fixed satellite services. Alternatives for introducing full flexible use should be considered as quickly as possible, as well. When coexistence challenges between mobile and FSS services have been resolved—which likely will require relocation of FSS operations—exclusively licensed mobile use of a portion of the 3.7–4.2 GHz band should be allowed, and fixed links should be repacked into the remainder of the band, which also can be used for mobile and other flexible uses as coordinated via a geolocation database.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read "Austin C. Schlick", written over a horizontal line.

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